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Monitoring of PCB, Hg and PAH Air Emissions in Sites Receiving Stabilized Harbor Sediment

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Funded by NJ Marine Sciences Consortium (NJMSC) and NJ Commerce and Economic Growth Commission, Office of Maritime Resources (NJEGC/NJMR)

Progress Report July 2001

General Information

The "Monitoring of Polychlorinated Biphenyls in Air Emissions" project was designed to assess the rate and magnitude of volatilization of PCBs from a site in New Jersey where treated sediments from the NY/NJ Harbor region are applied to land. Rutgers University has been funded to determine the background ambient PCB concentrations in the air in Bayonne, NJ prior to and after the land application of sediment. This will allow for the determination of the magnitude to which the land application of harbor sediments affects the ambient PCB concentrations in the air in Bayonne, NJ. Monitoring of PCB concentrations in air will begin immediately after the application and compaction of sediments to the land with the first sampling intensive campaign planned for July 17th through July 20th, 2001.

Progress

Background ambient air monitoring of PCBs commenced on 8 December 1999 at the NJDEP air sampling trailer located in Bayonne, NJ adjacent to Newark Bay. Twenty-four hour integrated air samples were collected at this site every 12 days. The Eisenreich laboratory has completed one year of background atmospheric sampling (Dec 1999 – Nov 2000). Thirty air samples have been collected; all of which have been analyzed for PCBs. Each sample is comprised of one polyurethane foam plug (PUF) and one quartz fiber filter (QFF), used to capture gas phase and particulate phase PCBs, respectively. The 30 PUF and 30 QFF samples, as well as 6 PUF and 6 QFF field blanks, were analyzed individually on the new Hewlett Packard Gas Chromatograph – Electron Capture Detector which was successfully installed 31 January 2000. Ninety-two individual PCB congeners have quantified in each sample.

A small-scale pilot study was initiated May 1, 2001 with the purpose of testing the air sampling equipment at the application site. The May 1st pilot study also allowed for the collection of a sample at the Bayonne application site representative of pre-dredged sediment application conditions. This first sample ran for approximately 5.5 hours and represented 193m^3 of air through the sampler. The PCB concentrations were significantly

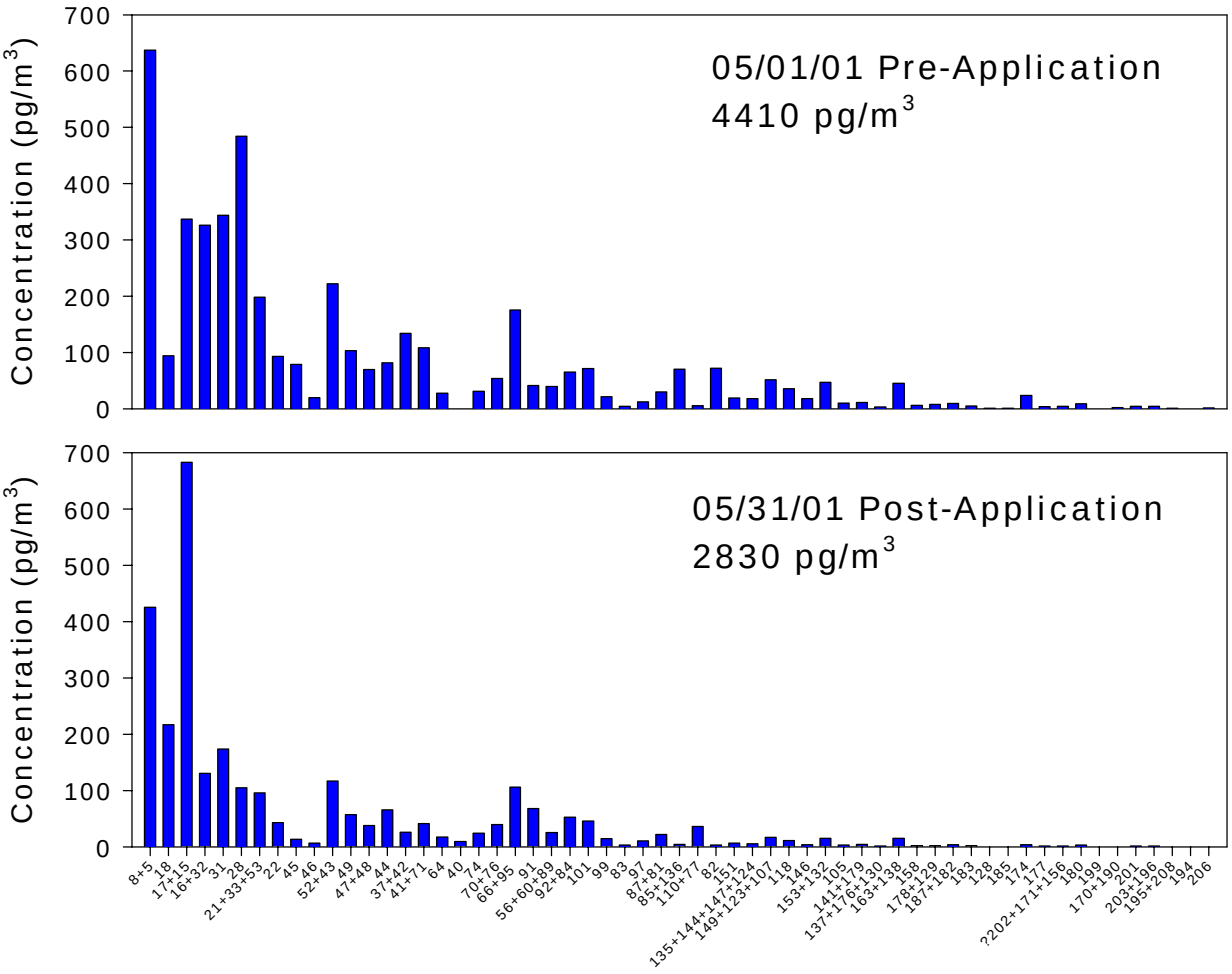
greater than instrument and method detection limits, thus this volume of air was adequate for the quantification of PCBs in the gas phase samples.

The first stabilized dredged harbor sediments were applied in mid-May 2001. The Rutgers team deployed another air sampler on May 31, 2001 after the sediment was applied which allowed for an initial comparison of pre-application PCB concentrations (May 1st sample) versus post-application PCB concentrations. This sample ran for 4.5 hours and represented 150 m^3 of air through the sampler. This smaller volume of air collected was also adequate for the quantification of PCB congeners.

Sample Data

The comparison between the pre and post-sediment application congener-specific PCB concentrations (gas phase) is presented in Figure 1.

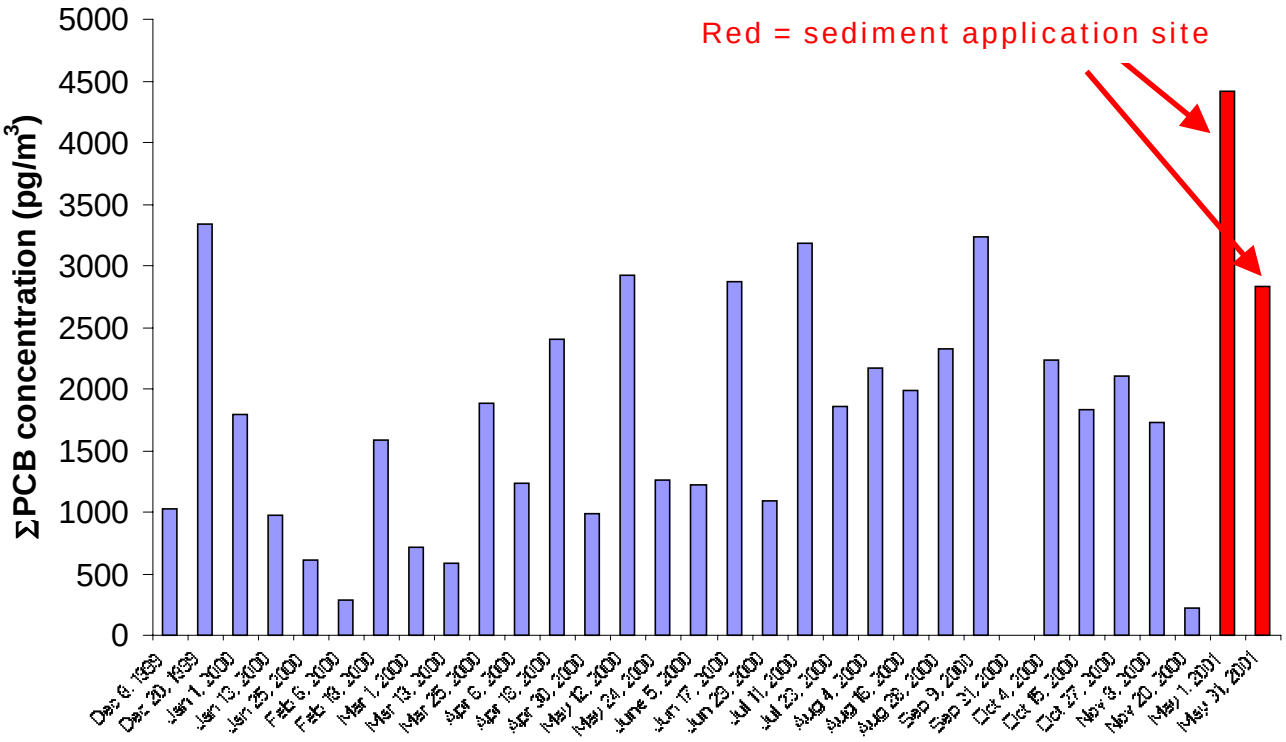
Figure 1.



Gas phase ΣPCB concentrations were found to be lower (1.5X) after the sediment was applied to the site at the end of May compared to the beginning of May. A regression between the relative congener profiles of the two samples gave an r^2 value of 0.55, indicating that the profiles are not statistically identical at the 95% CI.

We have added the two May 2001 sediment application site samples (red) to the graphic of the thirty gas phase air samples from the Bayonne trailer station collected from December 1999 to November 2000 (blue). Presented in Figure 2 are the ΣPCB (92) concentrations for these gas phase samples.

Figure 2.



Gas phase ΣPCB concentrations were highly variable over the year. Gas phase ΣPCBs at the DEP sampling trailer site (blue bars) differed by as much as an order of magnitude, ranging from approximately 220 to 3300 pg/m^3 with an annual average ΣPCB concentration for 1999-2000 of 1711 pg/m^3. The two samples taken at the sediment application site: May 1, 2001 (4410 pg/m^3) and May 31, 2001 (2830 pg/m^3) represent high ΣPCB concentration days, relative to concentrations at the trailer site. It is unclear at this point whether the two sampling locations "sense" similar PCB concentrations at the same time. This will be investigated during the first intensive sampling campaign in July 17-20, 2001, when samples will be taken simultaneously at the sediment application site and the Bayonne DEP trailer site.

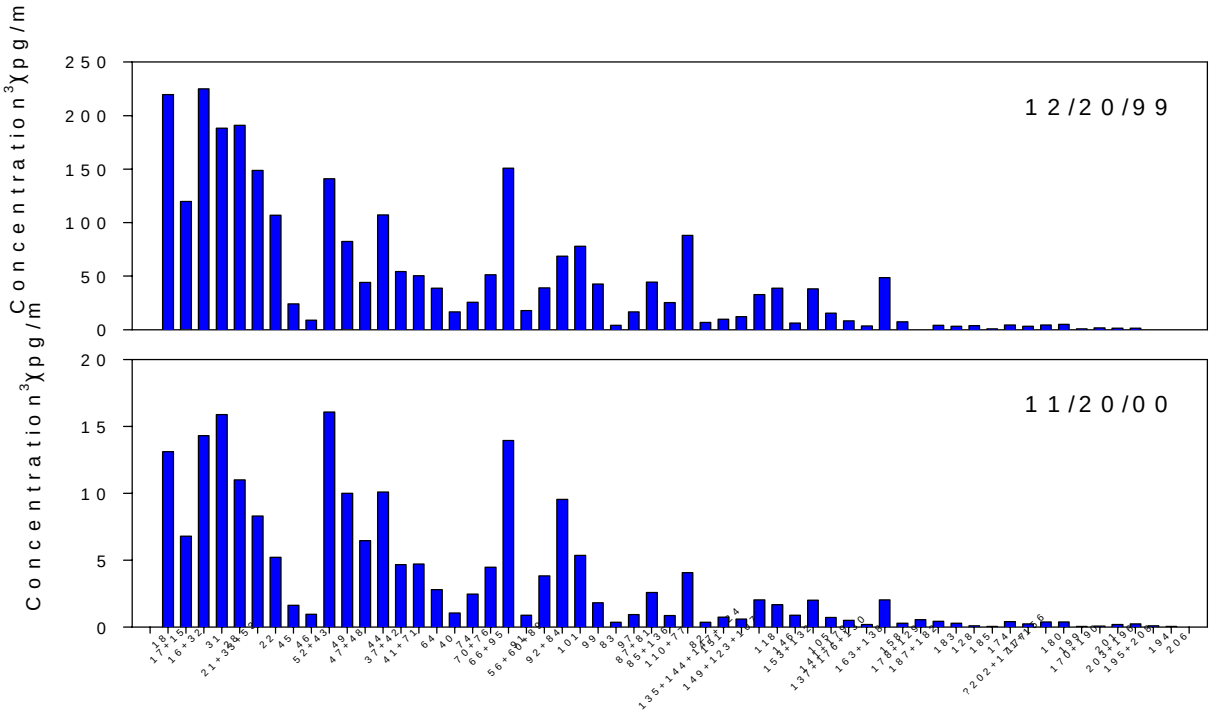
As discussed in the last progress report (March 2001), in order to perform some preliminary interpretation of this data, wind vector analysis was employed. The highest gas phase ΣPCB concentrations at the DEP trailer site adjacent to Newark Bay were measured on 20 December 1999 (3333 pg/m^3) and 9 September 2000 (3231 pg/m^3) (Figure 2). Wind vector analysis showed that the dominant wind vectors for the December date were easterly, northeasterly and southerly. On 20 September 1999, the

vector analysis showed a dominant northeasterly vector. The winds came over urban areas for both these vectors (east, northeasterly-over Bayonne; southerly-over Staten Island). The lowest gas phase ΣPCB concentrations at the DEP trailer site were measured on 6 February 2000 (279 pg/m^3) and 20 November 2000 (222 pg/m^3). In contrast to the high ΣPCB concentration days, these lowest concentration days have a dominant westerly wind vector component rather than an easterly. This very basic vector analysis provided evidence supporting that the Newark Bay, which is historically contaminated with PCBs, (located immediately west of the Bayonne trailer site) is not the largest source of PCBs to this area of Bayonne. It is likely that there are sources of PCBs in the immediate vicinity of the Bayonne sampling site in all directions including the city of Bayonne itself, the adjacent Newark Bay, the urban/industrial areas found surrounding the site, etc.

The wind direction was not the same on the two sampling days in May at the sediment application site. On 1 May 2001 (pre-sediment application), winds came out of the SW at an average wind speed of 4.5 m/s; whereas on 31 May 2001 (post-sediment application) winds came from the NW at an average wind speed of 7.0 m/s. ΣPCB concentrations at the DEP trailer site were lowest (222 pg/m^3) under southwesterly winds. Under this same wind vector at the sediment application site, we have measured concentrations ~20X higher (4410 pg/m^3). Located both to the SW and the NW of the sediment application site are very heavily industrialized areas, as well as the urban area of Bayonne, NJ. It is difficult to assess the reason why concentrations on May 31st are almost half those measured on May 1st based upon wind vector analysis of these two samples only, but there is certainly a wind speed effect. Average wind speeds were higher on the 31st (7 m/s) than on the 1st (4.5 m/s) which may have led to a dilution of the PCB signal. And although there may be an addition of PCBs from volatilization from the dredge material, this signal may be overwhelmed by the wind vector/wind speed influences and neighboring sources. With the limited amount of data gathered thus far, it is not possible to begin to assess the extent of the wind speed and wind vector influences at this time.

We have compared the congener-specific PCB profile from May 1st with the profiles seen at the trailer site under southerly wind vectors (Dec 20 – S and Nov 20- SW) in order to determine if the profiles are similar (Figure 3).

Figure 3



If there is one dominant source-type for PCBs that affects the Bayonne site, then the relative PCB congener distribution of each sample should be the same regardless of the total PCB concentration. In Figure 3, we have chosen to plot the gas phase PCB congener profile for the day with the highest concentrations (20 December 1999) and the day with the lowest concentrations (20 November 2000). Because the wind directions are different between the two days (12/20/99 – East and South) (11/20/00 – Southwest), the profiles can be compared to determine if Bayonne is affected by different source-types located in different directions.

A comparison of the two congener profiles shows that they are statistically similar at the 99% confidence level (r^2=0.86). This indicates that although the air is coming from different vectors, the source-type is the same. If we compare the profiles in Figure 3 to the profiles of the two samples taken at the sediment application site (Fig.1), we see that there is a stronger similarity (all p-values < 0.01) between the May 1st profile and the profiles from the DEP trailer (12/20/99: r^2 = 0.70 ; 11/20/00: r^2 = 0.60), than exists between the May 31st profile and the trailer site profiles (12/20/99: r^2 = 0.33 ; 11/20/00: r^2 = 0.26). Therefore, there appears to be another source type affecting the PCB profile on May 31st which is not seen at the site prior to sediment application and is not seen at the DEP trailer site. It is likely that we are seeing the influence of the dredged materials as a source of PCBs to the air at the sediment application site. However, it is inappropriate at this point in the study to draw any significant conclusions regarding the effect of the stabilized dredge materials on PCB emissions to the Bayonne region.

Future Work

The Eisenreich laboratory is awaiting the initiation of the first intensive sampling campaign planned for July 17 – 20th, 2001. All of the necessary sampling media for the campaign has been prepared and is ready for sampling. The sampling equipment (high volume air samplers and gas generators) are functioning properly and are ready for deployment in July.